Introduction to Energy Efficiency in Post Offices, Building Societies Banks and Agencies

BEST PRACTICE PROGRAMME

Energy Efficiency Office
DEPARTMENT OF THE ENVIRONMENT

Cover photograph: Nationwide Building Society

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1

INTRODUCTION

1.1 Who this guide is intended for

This guide is aimed at those responsible for energy in an estate of post offices, banks, building societies or high street agencies. In smaller organisations this may be the property manager and in larger organisations the corporate energy manager. The guide can also form the basis of material to be distributed to Branch Managers.

It is intended to introduce the steps that anyone responsible for energy needs to take in order to control and reduce energy consumption. It shows how to gain an understanding of energy use in these buildings and indicates the methods by which savings are likely to be made.

1.2 Use of the guide

This guide is one of a series for different types of building. A full list of titles is given in section 9.4; make sure that you have the guide most suited to your needs. This guide is not applicable to head offices, which are covered by the guide on offices.

If you are unfamiliar with energy management, you should start with section 2, Energy Management, in order to get an overview of the subject.

- The subsequent sections concern creating and following an action plan (section 3) and implementing measures to achieve energy savings (section 4). Sections 5 to 7 describe methods for assessing energy use in your estate or building.
- The case studies (section 8) give examples of branches where energy saving measures have been successfully implemented.
- Section 9 lists further sources of help and information, including addresses for obtaining copies of the information referred to throughout the guide.

More experienced energy managers or consultants may use the action plan (section 3), or the suggested measures (section 4) as aide-memoires. They may also use the method for calculating performance indices described in section 6 and appendix 1.

1.3 Environmental benefits of energy efficiency

Most of the energy used today originates from fossil fuels (gas, oil and coal). Burning fossil fuels emits pollutants, including gases that cause acid rain, and carbon dioxide. As carbon dioxide and other gases build up in the atmosphere, more of the sun's heat is trapped (the greenhouse effect). This could result in the earth becoming hotter (global warming), which may also increase the risk of storms, coastal flooding and drought. Using energy more efficiently is one of the most cost effective means of reducing emissions of carbon dioxide and also helps to conserve finite reserves of fossil fuels.

1.4 Financial benefits of energy efficiency

Energy is the largest controllable outgoing in running commercial buildings. Using simple and cost effective measures, fuel bills can often be reduced by an average of about 20%. Further savings are possible in new construction and when buildings are refurbished or their services replaced.

Well designed and efficiently managed services not only result in energy savings, but also in an improved and more comfortable environment for customers and staff. This can give rise to better productivity and increased custom.

1.5 Acknowledgements

This guide was prepared for the Energy Efficiency Office (EEO) by Target Energy Services Ltd. The EEO gratefully acknowledges the assistance given by the following organisations in providing information:

The Automobile Association

Barclays Bank plc

Building Energy Solutions

Nationwide Building Society

Lloyds Bank plc

Post Office Counters Ltd

ENERGY MANAGEMENT

2.1 Energy efficiency - a management issue

The aim of energy management is to ensure that energy use and energy costs are as low as possible while standards of comfort, service and productivity are maintained or improved. This requires somebody to be directly responsible for energy efficiency, even if this is only a part of their job:

- As a rule of thumb, organisations or sites with an energy bill over £1 million may justify the employment of a full time energy manager. Otherwise, energy management will normally be combined with other responsibilities.
- In organisations with an estate of buildings, energy efficiency should be managed centrally.
- Each building should also have someone responsible for energy management.
- Energy efficiency must be strongly supported at the highest levels with the authority and resources needed for initiatives to be effective.

Encourage your management board to sign up to the EEO's Making a Corporate Commitment campaign if it has not already done so (see section 9.5).

The duties and functions of an energy manager responsible for an estate of buildings are outlined in this section. Section 3 includes a suggested action plan which can be used to get things moving.

For further information see:

EEO General Information Report 12 - Organisational aspects of energy management
EEO General Information Report 13 - Reviewing energy management
Making a Corporate Commitment - various guides

2.2 Controlling energy use

To control energy consumption and costs, regular and reliable records of energy use should be maintained. Such records will help to identify changes in energy costs and consumption. This is commonly called monitoring and targeting or M&T. The simplest arrangement is a form which can be filled in regularly for each fuel, recording monthly energy use. Alternatively, systems can be based on a computer spreadsheet, or commercially available software systems can be purchased. Computer based systems are essential for effective monitoring of a large estate.

An M&T system should:

- Record energy consumption and any other factors that affect energy use (building usage, weather, productivity, etc).
- Compare a site's energy use to previous years, to other buildings in the estate, or to yardsticks representing typical or target energy performance.
- Alert you to sudden changes in energy use patterns as soon as possible, so that any increase can be investigated and corrected if appropriate.
- Produce regular summary reports, especially if there are many sites, to confirm performance and show savings achieved overall.

If fuel bills are not available or some are missing, then duplicates can usually be obtained on request from the relevant fuel supply company. Meters should be checked every few months to ensure that billed readings are correct. In shared or multi - meter sites ensure you are being billed for your use; label your meters.

Example recording of monthly electricity use

Period: *JAN-DEC 92* **Completed by:** *NJK* **Date:** *10.2.93*

Meter Reading Date	kWh Used	Cost £
8.1.92	39,700	2756.29
5.2.92	38,700	2653.65
5.3.92	31,500	2200.35
9.4.92	25,000	1584.02

2.3 Getting on the right tariffs

Making sure that fossil fuels and electricity are purchased at the cheapest rates is increasingly important. Considerable cost savings are sometimes possible by changing to more suitable tariffs for electricity, or by making alternative supply arrangements.

It may also be possible to reduce energy costs by negotiating single purchase agreements for all the buildings in an estate.

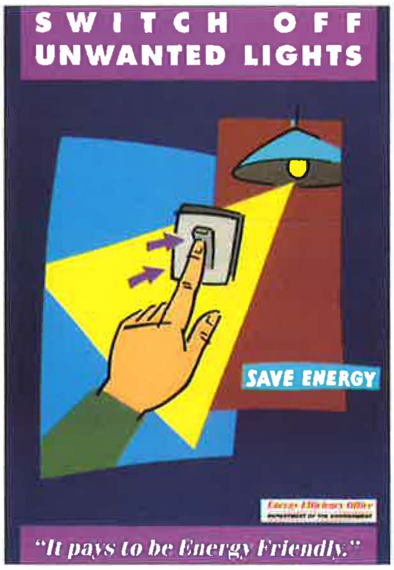
Tariff savings usually incur little or no initial cost and may be used to help finance measures to reduce energy costs further. Reviewing tariffs should therefore be one of your first actions:

- Seek alternative electricity tariffs from your existing supplier.
- Check that the supply capacity for electricity at each site (the agreed maximum available supply charged as shown on your electricity bill) is not excessive compared to the existing or expected maximum demand.
- Consider using other electricity suppliers in the contract market when the supply is for more than 100 kW (representing a bill of around £30,000 a year).
- Consider a different supplier for oil, or for gas supplies over 70,000 kWh a year (representing a bill of around £1,000 a year).
- For large sites with complicated tariffs and load patterns, it may be worth employing a tariff consultant, although be aware of consultants' costs (contact the Energy Systems Trade Association (ESTA) or the Major Energy Users' Council, see section 9.9).

For further information see:

Fuel Efficiency Booklet 9 - Economic use of electricity in buildings.

Energy Efficiency Poster



2.4 Actions and measures to save energy

One of your main activities should be to identify areas of energy waste and implement energy saving measures to reduce them. Some waste is simple to diagnose and to correct, for example unnecessary lighting left on all night. Other waste may be more difficult to identify and take more expertise or resources to correct (see section 4).

If you are a central energy manager, you will be responsible for many separate locations. For large estates, savings can be maximised by employing energy saving measures and initiatives which can be widely applied across the majority of premises. These measures should be easy to implement, manage and follow up.

A good working knowledge of the estate is required to identify these measures. This can be gained by:

- Visiting sites and then considering a programme of standard energy surveys
- Reviewing building services specifications
- Talking with refurbishment design staff, consultants and maintenance and other contractors.

Your first priority should be to establish a comprehensive and reliable M&T system and have good site information. The most suitable branches for energy surveys can then be identified by producing a league table of performance indices (see section 6) and starting with the worst performers.

For more complex measures, conduct trials at selected sites to establish payback periods and installation and operating parameters, such as the best location for equipment and the optimum control settings.

2.5 Interaction with other groups in the organisation

Guidelines showing the cost and environmental benefits of energy conservation together with a package of information explaining simple energy saving measures should be disseminated to each branch. In large organisations it will be impracticable for the Energy Manager to liaise directly with each branch, and the existing management structure should be utilised. For example: Energy Manager → Area Manager → Branch Manager → branch staff.

In organisations with smaller estates, you may find it possible to deal directly with each site.

You should ensure that someone is responsible for energy management in each building, ideally the Branch Manager, and provide training through seminars and literature. Literature might include checklists such as the one in section 4.1. Managers' responsibilities would include:

- Briefing all branch staff on how to operate controls
- Undertaking walk arounds to identify avoidable waste
- Acting as an interface between branch staff and the central energy manager for comments reflecting dissatisfaction and suggestions for energy saving measures.

2.6 Motivating staff

The greatest possible savings can only be achieved with the cooperation of staff throughout a site or organisation. Foster their support and give staff every chance to participate in energy saving initiatives. Feed back information to staff on the results of these initiatives.

The primary motivation for Area and Branch Managers will be the financial benefits to area/branch operating performance. Set targets and produce league tables of performance trends within an area to provide an additional incentive to Branch Managers through peer competition. Branch staff may be motivated more by the environmental benefits and the improved levels of comfort.

Awareness and motivation can be further raised by energy and environmental messages from senior management using staff magazines and videos and by the production of company posters, stickers and leaflets.

You should monitor the savings achieved and publicise them to help motivate staff and senior management. Obtaining capital investment for future energy efficiency measures may depend on demonstrating the cost effectiveness and the environmental benefits of measures that have already been completed.

For further information see:

EEO Good Practice Guide 84 - Managing and motivating staff to save energy.

2.7 Refurbishment and new construction

Energy efficiency measures are most cost effective when installed in new or refurbished buildings, or while replacing equipment which is at the end of its normal life. New items of equipment which are required anyway should be as efficient as possible. Additional items to improve energy efficiency can be installed most cheaply during other building work. These special opportunities to incorporate energy efficient design are relatively rare and should not be missed.

You should be involved in decisions about new or refurbished property and should not just be brought in to correct high energy use following decisions made by others. Your knowledge of how the buildings in your estate are used should be drawn on when specifying appropriate levels of services and controls.

When moving or refurbishing premises, take the opportunity to select or specify:

- Energy targets
- The type of accommodation - for example, the inclusion of full or partial air conditioning may double overall energy costs
- Systems which are suitably simple and within the capabilities of the occupants to manage
- Fossil fuel rather than electric heating where possible
- High efficiency of major plant and equipment such as boilers or main lighting systems
- Good levels of insulation
- Appropriate controls for the anticipated pattern of use
- Suitable metering and monitoring facilities
- Information, advice and training for staff in the use of new systems.

For further information see:

EEO Good Practice Guide 34 - Energy efficient options for new offices - for the design team.

EEO Good Practice Guide 35 - Energy efficient options for refurbished offices - for the design team.

EEO Good Practice Guide 71 - Selecting air conditioning systems.

Refurbishment offers a rare opportunity to incorporate many energy efficiency measures.

2.8 Getting help

Sources of further information are described and listed in section 9.

To obtain further information about possible energy saving measures (see section 4), contact relevant manufacturers, installers or service providers who will advise you of the features of their products. Make sure that these features are relevant and appropriate to your requirements. Gas and electricity suppliers can also offer advice.

If time is not available or if discussions with a selection of competing suppliers do not provide a consistent picture, it may be worth hiring a professional consultant to provide advice or to conduct an energy survey. For organisations with less than 500 employees the EEO's Energy Management Assistance Scheme (EMAS) may offer financial help towards energy consultants' fees (see section 9.5).

If the availability of finance and management time is a problem for opportunities requiring substantial investment, contract energy management (CEM) organisations may provide a solution - they offer a comprehensive service including finance and management responsibility. ESTA can provide a list of companies (see section 9.9).

For further information see:

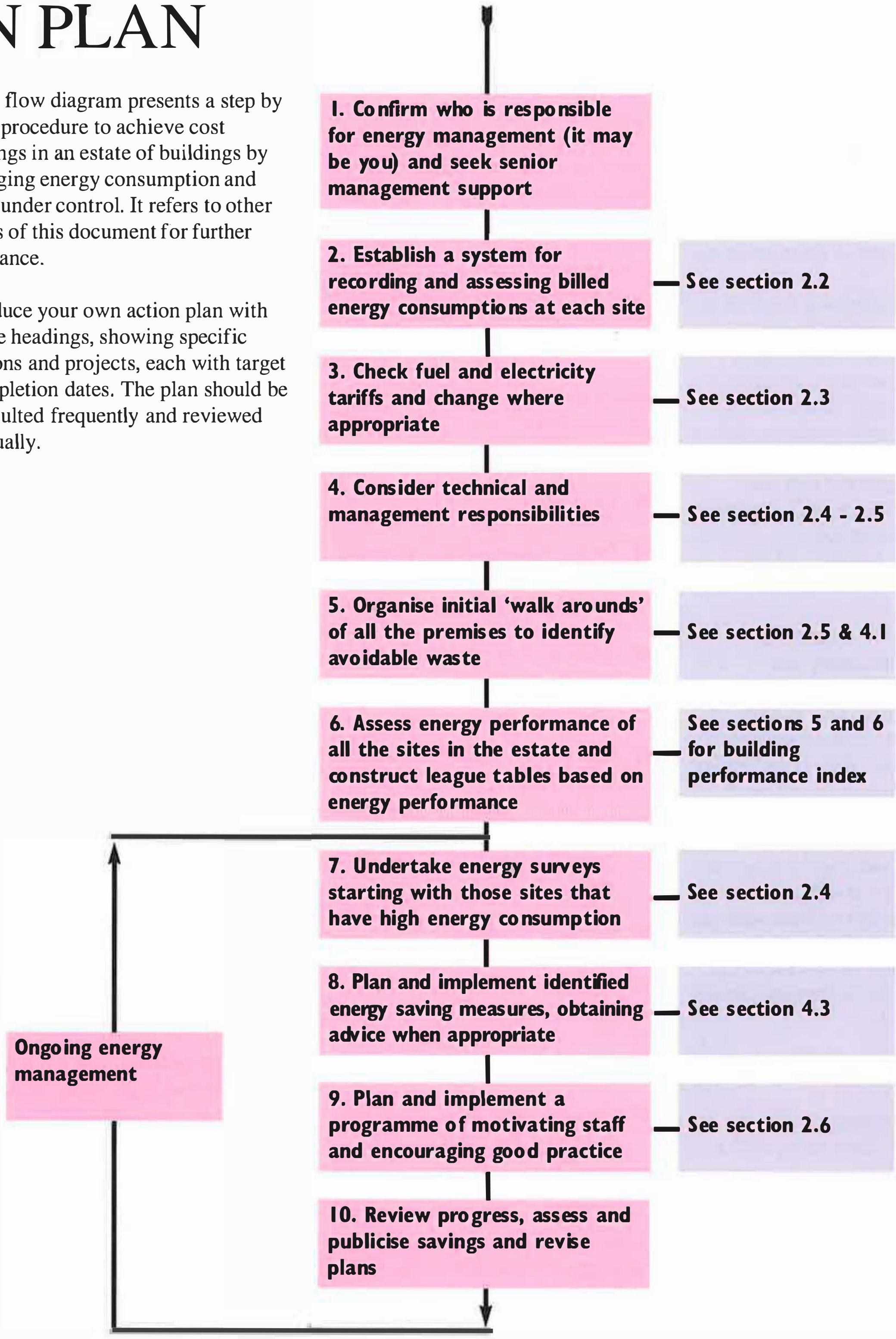
Choosing an Energy Efficiency Consultant (EEO).

3

ACTION PLAN

This flow diagram presents a step by step procedure to achieve cost savings in an estate of buildings by bringing energy consumption and cost under control. It refers to other parts of this document for further guidance.

Produce your own action plan with these headings, showing specific actions and projects, each with target completion dates. The plan should be consulted frequently and reviewed annually.



MEASURES TO ACHIEVE ENERGY SAVINGS

4.1 Initial measures

In most buildings it is possible to make some savings by using the existing building and equipment as efficiently as possible. No financial investment is needed; instead, a check on how the building is being used may reveal areas where equipment can be turned off when it is not needed, or where the level of service can be reduced without affecting the comfort of staff or customers.

Some opportunities may be easy to identify and implement, such as altering thermostats or timeclocks. Others, such as turning lights off when rooms are not being used, may require the cooperation of staff. Motivating staff to help is therefore important, although a long term task. The list below indicates the type of items to check in an initial assessment of 'good housekeeping' opportunities. An exercise to review energy purchasing tariffs (see section 2.3) should be carried out at the same time.

Checklist of Initial Energy Saving Measures

Space and water heating

- Consider fuel switching (if your boiler(s) can operate using more than one fuel).
- Check that time switches are set to the minimum period and ensure that room thermostats and radiator controls are on minimum settings commensurate with comfort conditions.
- Ensure that only occupied areas are heated, and that heating is off or reduced in non-working hours.
- If you have a building energy management system (BEMS), check that it is operating correctly and ensure that operators are trained to use it effectively.
- Reduce temperature of stored domestic hot water by turning down the thermostat to a minimum of 60°C, but no lower because of the risk of Legionella.
- Make sure that pumps are running only when required.

Lighting

- Ensure that someone is responsible for switching off in each room or area when not in use.
- Make the best use of daylight by keeping windows and roof lights clean and by using working areas near windows where possible; encourage staff to turn off lights when daylight is good.
- Investigate existing lighting controls to see if the hours of use of artificial lighting can be reduced.
- Install 'task' lighting where this means that background artificial lighting levels or hours of use can be reduced.
- Avoid excessive lighting levels and hours of use in corridors. Where fluorescent lighting is used, it may be possible to reduce the number of tubes in luminaires.
- Turn off lighting in customer areas outside opening hours where possible.

Ventilation

- Ensure the main ventilation plant and toilet extractor fans are switched off outside occupancy hours. If possible, switch off the plant that serves customer areas outside opening hours.
- Check that windows are not being opened to avoid overheating during winter.
- Ensure kitchen fans are switched off when no cooking is taking place.
- Ensure door closers operate effectively and that main doors are not jammed open during hours of use.
- If a warm air curtain is provided over the main doors, ensure it only operates in winter months when the doors are open.

Air conditioning

- Set temperature controls for cooling to 24°C or higher - lower settings require more cooling energy and may be 'fighting' the heating.
- Where the design permits, ensure heating and cooling are not on at the same time in the same part of the building (the advice of a consultant or on site services engineer may be needed). For example, ensure that the controls of any ceiling cassettes are set so that cassettes in the same space do not provide heating and cooling at the same time.
- Make sure that refrigeration plant such as chilled water systems do not run unnecessarily.
- Ensure that fans and pumps do not run when not required.

Office equipment

- Encourage staff to turn off office equipment when it is not being used, particularly at lunchtime and at the end of the working day.

Controls

- Ensure all controls are labelled to indicate their function and, if appropriate, their new reduced settings.
- Establish responsibilities for control setting, reveiw and adjustment.

Building fabric

- Ensure all insulation is in a state of good repair.

4.2 Maintenance

Regular maintenance is a prerequisite to controlling energy costs and is also essential for maintaining a healthy environment in buildings.

Maintenance contractors can be a useful source of information about buildings and services. If suitably qualified, they can also be used cost effectively to undertake brief energy surveys and to install simple energy saving measures, such as timers and insulation.

A maintainance programme should include:

- Replace filters at the manufacturer's recommended intervals and keep heat exchanger surfaces, grilles and vents clean in order to allow unobstructed flow of air
- Check plant operation and controls regularly
- Ensure that all motorised valves and dampers fully open and close without sticking
- Check that thermostats and humidistats are accurate
- Check calibration of controls
- Check time and temperature settings of electric panel and storage heaters
- Service the boiler plant and check combustion efficiency regularly
- Look for water leaks and carry out repairs where necessary
- Clean windows to maximise daylighting
- Replace 38mm diameter fluorescent tubes in switch start fittings with 26mm diameter high efficiency triphosphor tubes as the former expire (see diagram on page 10)
- Clean lamps and luminaires regularly and replace at the manufacturer's recommended intervals.

4.3 Longer term measures

There will almost certainly be items of equipment or insulation which could be replaced with more efficient alternatives. The main areas for savings, starting with the most cost effective, are:

- Control systems
- Lighting and office equipment
- Heating and air conditioning plant
- Building fabric.

Care is required in deciding which measures to implement and the most effective way of carrying them through. In the first instance, measures should be undertaken which have as many of the following features as possible:

- Worthwhile energy and cost savings
- Low capital cost
- Short period to repay initial cost
- Widely applicable across the estate
- Little technical knowledge required
- Little or no extra maintenance
- Little or no disruption to normal operations.

Further information is given in references listed in section 9 - note particularly:

EEO Fuel Efficiency Booklets:
1 Energy audits for buildings
8 The economic thickness of insulation for hot pipes
10 Controls
12 Lighting

EEO Good Practice Guides:
35 Energy efficient options for refurbished offices
46 Heating and hot water systems in offices

Energy Efficient Lighting in Buildings. A THERMIE Maxibrochure.

Assessing costs of measures

The cost effectiveness of an energy efficiency investment can be expressed as the initial cost divided by the monthly or annual cost savings - the simple payback period.

More sophisticated appraisal techniques for comparing different investments, such as 'discounted cash flow' methods, are sometimes used in larger organisations and for major investments. If these are needed, advice should be sought from those who use these methods. If energy-saving initiatives are taken during refurbishment or when moving, capital cost is often substantially reduced and interference with normal working practices is kept to a minimum.

For measures included during replacement or refurbishment, the initial cost (for calculating the payback period) is only the over-cost: for example, the extra cost of a high efficiency 'condensing' boiler compared with a conventional boiler. This reduces payback periods and increases cost-effectiveness.

In some cases, energy efficiency measures can reduce overall capital costs, such as providing natural ventilation which avoids the need for air conditioning.

Where shortage of funds and/or lack of expertise is holding up promising measures, it may be worth considering contract energy management as described in section 2.8.

Measures can be split into those which require limited attention such as insulation, and those which require management time to ensure that they continue to be effective, such as building energy management systems. For the latter, manageability is as important as the potential for energy savings, and should be a prime consideration in the design.

LIGHTING

Lighting is one of the largest energy costs in Post Offices, banks, building societies and agencies, and good savings can be achieved by ensuring that the lighting equipment and its controls and management are of a

high standard.

The energy used for lighting depends upon the energy consumption of the lamps and the hours of use. The most efficient systems are well designed, and have efficient lamps and fittings which provide the required level of illuminance (without over-lighting). They have controls which enable the lights to be switched off when they are not required, whether because a space is not being used or because there is sufficient daylight.

All new lighting in areas with VDU equipment must comply with the Health and Safety (Display Screen Equipment) Regulations 1992 which implement the 1990 European Directive 90/270/EEC. Lighting for existing work stations must comply by 31st December 1996. Wherever lighting is upgraded, it offers an opportunity to select the most energy efficient options.

Some types of lamps, in order of increasing efficiency, are:

- 'Domestic' tungsten bulbs - very inefficient; should usually be replaced
- Tungsten spotlights - used for display lighting; even the most efficient lamps are much less efficient than fluorescent lamps
- Compact fluorescent lamps - efficient replacements for tungsten bulbs, although not as efficient as modern tubular fluorescent lamps
- Fluorescent tubes - used in most office areas
- Metal halide and sodium discharge lamps - these vary in efficiency depending on type (most are more efficient than fluorescent tubes). Sometimes used in uplighters; well suited to lighting large areas such as car parks.

Luminaires, left to right: recessed mirrored reflector with louvres, batten fittings, opal, and prismatic diffusers.

Photographs supplied by Philips and Fitzgerald.

Figure 4.1 Typical relative energy consumption

lamp type	typical energy consumption relative to tungsten bulbs for similar levels of lighting (%)
tungsten filament bulb	100
tungsten halogen spotlight	70
compact fluorescent with electronic ballast	18
metal halide (MBI)	15
high pressure sodium	11
Fluorescent tubes:	
(1) choke & starter control gear with 38mm diameter tubes	18
(2) as 1), but 26mm diameter high efficiency triphosphor tubes	16.5
(3) as 2), but with electronic ballast	13

Tungsten bulbs typically have a life of about 1,000 hours, while fluorescent and discharge lamps typically last for 8,000 hours or more. Removing tungsten bulbs therefore gives substantial savings in maintenance costs in addition to any energy savings.

Typical levels of energy consumption of different types of lamp, expressed as a percentage relative to tungsten lamps, are given in figure 4.1.

These figures give an indication of the typical savings which may be made by replacing lamps with more efficient alternatives. For example, replacing an old inefficient tubular fluorescent system (1) with a modern efficient system (3) would reduce energy consumption by a factor of 13/18, a reduction of about 30%.

As well as lamps, light fittings (luminaires) contain a number of other elements, including:

- Diffusers or louvres - these are designed to give a good distribution of light without glare. Luminaires with prismatic and especially opal diffusers are less efficient than those with reflectors.
- Control gear - fluorescent and other discharge lamps need control gear to strike up and maintain light output. Old fluorescent luminaires have chokes and starters; modern electronic controls

Compact fluorescent lamps

(ballasts) are more efficient.

Lighting controls should be used to ensure that, as far as possible, lights are off when they are not needed.

Lighting controls include:

- Manual control - it should be possible to control all lights manually, whatever automatic controls are also used
- Time controls - allow any group of lights to be switched on or off automatically at set times of the day
- Presence detectors - automatically switch lights on when somebody enters a space, and off again after the space is vacated
- Daylight detectors - allow groups of lights to be switched off or on according to the level of daylight. Some lights can also be dimmed as daylight levels alter.

LIGHTING MEASURES

- Replace tungsten lamps with compact fluorescent lamps or, better, with tubular fluorescent lamps.
- Replace tungsten spotlights with low voltage tungsten halogen lamps but only where these are used for display purposes; otherwise replace with compact fluorescent spotlights.
- Replace existing control gear in fluorescent fittings with electronic, high frequency ballasts.
- Replace diffusers in tubular fluorescent fittings with reflectors and reduce the number of tubes if possible.
- If light fittings are over 15 years old, replace with new efficient fittings and consider installing new lighting controls.
- Use metal halide or sodium discharge lamps for outside areas such as car parks.
- Improve lighting controls, including:
  - local manual switching, such as pull cords on lights, so that all staff have control over their local lighting, particularly in open plan offices
  - time controls for office areas which, for example, switch off at lunch time and the end of the day (ensure they are switched off in stages)
  - time controls or daylight detection controls for external lighting
  - presence detection controls for corridors and stairs (excluding emergency lighting) and for areas which are infrequently used, such as stores
  - daylight detection controls for lighting in offices adjacent to windows.

HEATING

The cost of providing heat for space heating or hot water depends on the cost of the fuel used, the efficiency of conversion of fuel to heat, and the extent of the distribution losses in supplying the heat when and where it is needed.

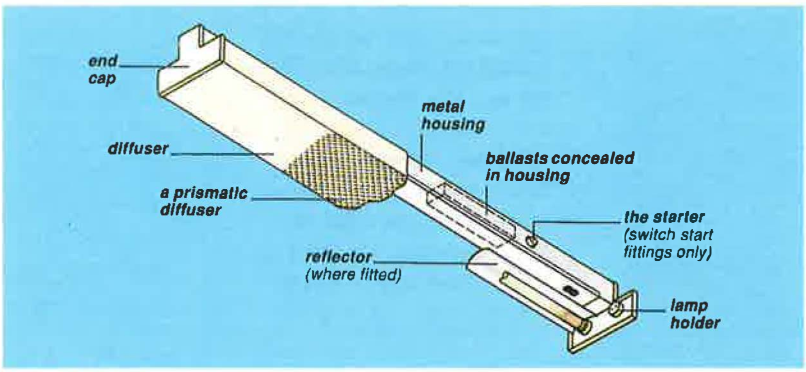
Boiler systems

Fossil fuels such as gas, oil or coal are burnt in a boiler and the heat is transferred to a heating system. Boilers have varying seasonal efficiencies - old boilers may convert less than 50% of the energy content of the fuel into heat in the heating system, while the most efficient gas condensing boilers may achieve seasonal efficiencies of over 90%. Condensing boilers can be used with most existing heating systems and ought to be considered whenever boilers are replaced.

Electric systems

Electric heating can be provided by panel, storage or fan coil heaters or by electric heat pump. Due to the significantly higher cost of electricity, panel and storage heaters are more suited to smaller dispersed rooms, or in premises where gas or oil is not available. Storage heaters make use of cheaper night rate electricity, if metered, but are less easily controlled and are therefore less efficient. Electric heat pumps allow one unit of purchased electricity to provide one to three units of heating, but their running costs still tend to be higher than fossil fuelled systems. Heat pumps generally can provide cooling as well as heating and are usually installed where there is a need for cooling.

Heat is lost from the heating system through ductwork, pipework, valves and hot water storage tanks. Pipe runs should therefore be short, and all parts of the system well insulated. Heat should only be supplied to a space or to produce hot water where and when it is needed. Where possible, large boilers should not be operated to meet small loads, as the efficiency will be very low.



The parts of a fluorescent light fitting

Effective heating controls are essential. Types of control include:

- Simple time control: a time switch that turns heating on and off at a fixed time each day - seven day time switches allow for variable occupancy during the week. Some heaters are fitted with individual time switches.

- Optimum start control: switches the heating on so that the building reaches the desired temperature just in time for occupation

- Weather compensation: varies the heating according to the outside temperature

- Room thermostat: keeps the temperature in a room to a required level. Some heaters are fitted with their own air thermostat.

- Thermostatic radiator valves (TRVs): regulate the flow of hot water through the radiators in a room in order to maintain a local temperature

- Boiler sequence control: enables only the number of boilers required to meet the system demand.

The 1990 Building Regulations specify that new non-domestic buildings should have time and temperature controls; and that large buildings should also have optimum start and boiler sequence controls.

HEATING MEASURES

- Separate the heating system into zones so that areas of the building with different heating requirements, such as customer and service areas, can be controlled separately.

- Fit TRVs to radiators in rooms which are prone to over-heating, due to solar gain, for example.

- Upgrade heating controls - in larger branches, controls should include a seven day programmable timer, with weather compensation of any heating circuits and optimum start control; smaller branches may only justify a seven day timer and thermostat.

- Where small volumes of domestic hot water are required a long way from the main heating plant, consider installing local instantaneous water heaters.

- Install spray taps where possible.

- Insulate hot water tanks and boilers, and all pipework, valves and flanges which do not provide useful heat to occupied spaces.

- Replace an old boiler installation with one that provides a minimum seasonal efficiency of at least 80%, preferably including at least one condensing boiler. Specify multiple boilers with a sequence controller rather than one large boiler in installations over 100kW, with the most efficient boiler leading the firing sequence.

- Ensure that boilers can only run when there is a heat demand. Unnecessary firing is known as "dry-cycling" and is often remedied by correctly wiring the boiler thermostat into the control system. In multi-boiler installations, wide band thermostats often overcome dry-cycling.

- Install a heater other than the main boiler to produce domestic hot water, and turn off the main boiler during the summer.

- Install temperature and time control of electric panel and storage heaters.

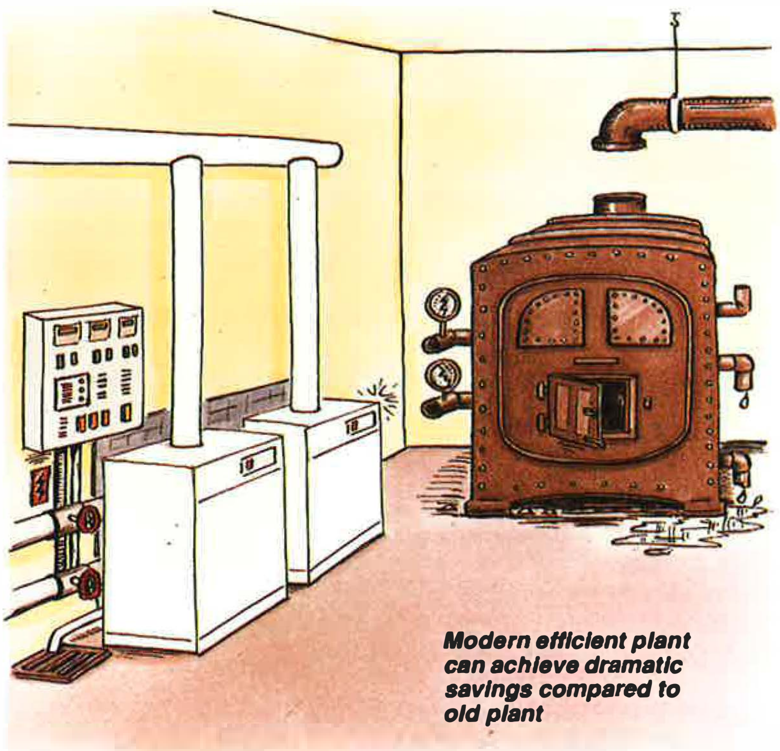
- Fit weather compensation control to the heat input of electric storage heaters.

MECHANICAL VENTILATION AND AIR CONDITIONING

Central mechanical ventilation provides air which is filtered and if necessary heated. Full air conditioning additionally provides cooling and humidity control.

Cooled air can also be provided locally by ceiling-mounted cassette or locally-ducted units which recirculate room air.

Cooling is usually provided by electrically driven refrigeration equipment or reverse heat pumps that can also provide heating. Cooling systems should be controlled and insulated in the same way as heating systems. The savings will be proportionally higher as cooling is considerably more expensive to produce than heat.



Modern efficient plant can achieve dramatic savings compared to old plant

Pumps and fans consume a considerable amount of energy; in fully air conditioned buildings they typically consume at least half, and often more, of the total energy used for air conditioning.

MECHANICAL VENTILATION AND AIR CONDITIONING MEASURES

- Install variable speed controls on fans and pumps; these allow motor speeds to be controlled according to the demand instead of running at full power continuously.
- Check the location of temperature sensors and controllers for cassette units and relocate if they are not effectively controlling the units to provide the required conditions.
- Ensure that controls are set or improved to avoid both heating and cooling air at the same time.
- Ensure that air conditioning systems make use of outside air for 'free cooling' whenever possible.
- When heating or mechanical cooling is required, ensure that the proportion of air recirculated within the building is as high as possible within the requirements for minimum fresh air rates.
- If humidifiers are being replaced or specified, use ultrasonic humidification (but ensure that precautions are taken to avoid Legionella).
- Explore the opportunities for heat recovery from any source of warm exhaust air but bear in mind the increase in pump and fan power that will be required.

BUILDING FABRIC

Most building fabric measures except simple roof insulation and draught proofing are most cost effective when they form part of general maintenance or refurbishment.

Caution: Insulation measures should be checked for condensation and water penetration risks.

BUILDING FABRIC MEASURES

- Insulate roof voids.
- Draught proof around windows and doors.
- Fit secondary glazing.
- Install cavity wall insulation or internal or external insulation.
- Reduce excessive glazing areas by replacing the glass with insulated wall panels.
- If windows are being replaced, fit multiple glazing, preferably with low emissivity glass which reduces heat loss in winter.
- Provide window blinds to minimise summer solar heating.

BUILDING ENERGY MANAGEMENT SYSTEMS (BEMS)

BEMS are computer-based systems which automatically monitor and control a range of building services such as heating, air conditioning, ventilation and sometimes lighting. They may also provide data on energy performance to enable energy savings to be targeted. They are most cost-effective in large buildings with complex building services.

Caution: A BEMS should be considered as an aid to management and not a substitute for it, and it is important that someone manages it to ensure that it operates effectively.

OFFICE EQUIPMENT

Office equipment can consume a significant amount of energy, although the levels are often over-estimated. Instigate a policy of purchasing equipment with low energy consumption. Consider both the consumption of equipment when running, and also the provision of low energy standby states when not in use.

ENERGY USE PATERNS

5.1 Why analyse building energy use?

Assessing the energy performance of a building allows you to:

1. Compare performance with standards to suggest the potential for energy saving in the building.
2. Compare with other buildings in an estate or group of buildings to help identify which should be investigated first.
3. Compare with performance in previous years to monitor progress and to assess the effect of any changes or energy saving measures.
4. Consider the energy use in more depth to help understand where energy is used and wasted, and hence where savings are most likely to be made.

A general understanding of what electricity and fuels are used for helps to concentrate attention on priority areas, especially where the use of one of the fuels is particularly high.

5.2 Types of building and their energy use patterns

The buildings covered in this Guide have been categorised as follows:

- Post Offices with a fossil fuel and electricity supply
- Post Offices with electricity only
- Banks and building societies with a fossil fuel and electricity supply
- Banks and building societies with electricity only
- Agencies with a fossil fuel and electricity supply
- Agencies with electricity only

Typical energy costs of the six types are shown in Figure 5.1.

Figure 5.1 shows that energy costs are greater for all-electric buildings than for buildings that use both fossil fuel and electricity. For these types of building, therefore, it is generally more expensive to use electricity for space heating than to use a fossil fuel such as gas or oil.

Figures 5.2 and 5.3 show typical energy cost breakdowns for banks and building societies, and Post Offices and agencies, that use fossil fuels and electricity.

Electricity is a high proportion of the total energy cost in banks and building societies owing to high lighting levels, office equipment such as computers and photocopiers and in some cases air conditioning.

Post Offices and agencies generally have lower levels of lighting, less office equipment and are rarely air conditioned. A higher proportion of the total energy cost is therefore associated with heating.

Figure 5.1 Typical energy costs

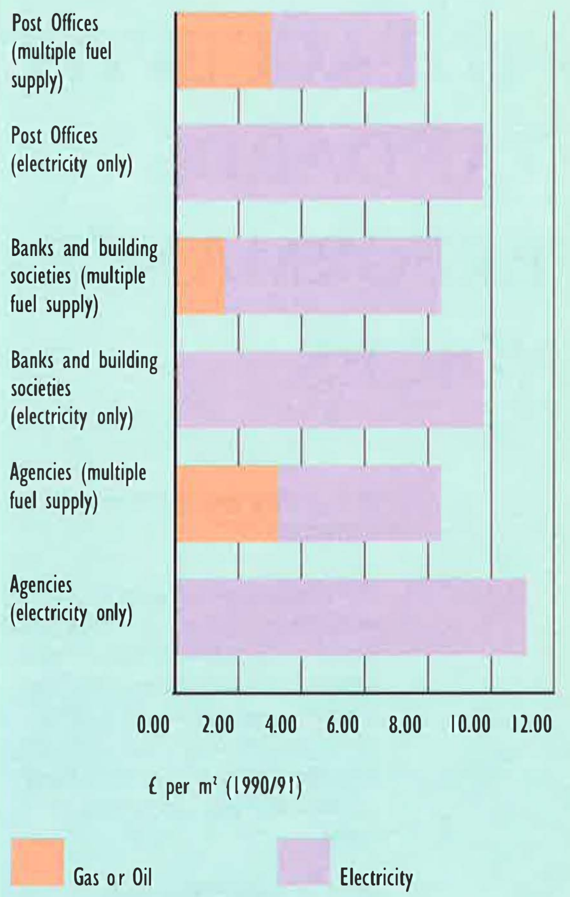


Figure 5.2 Typical energy cost breakdown for banks and building societies

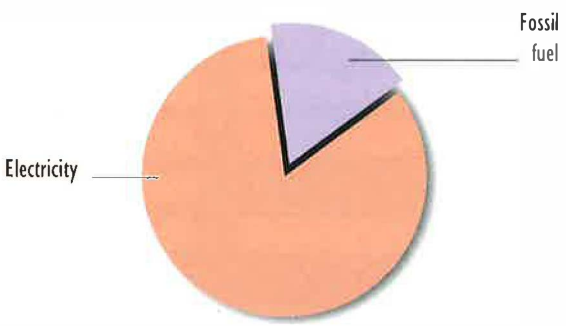
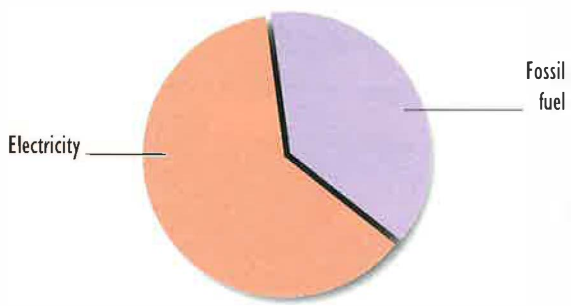


Figure 5.3 Typical energy cost breakdown for Post Offices and agencies



6

COMPARING WITH ACCEPTED STANDARDS - PERFORMANCE INDICES

6.1 Why use performance indices?

Performance indices give a measure of the energy use of a building which can be compared with the yardsticks. They can indicate the potential for improvements and can be used to show progress over time. They can also allow comparisons to be made between buildings in a group or estate.

6.2 Calculating the performance indices of a building and comparing to yardsticks

Two separate indices are calculated for the building, one for electricity and the other for fossil fuels. The separate indices should not be added together, because of the different cost and environmental impact of fossil fuels and electricity. For all-electric buildings a single performance index is calculated.

The performance indices are obtained by dividing the annual building energy use by the floor area. Yardstick values for the different building types are given in figure 6.2, with electricity consumption and fossil fuel energy consumption shown separately when appropriate.

The procedure is:

1. Enter the annual energy use for each fuel into column 1 of figure 6.1.
2. Multiply each fuel by the conversion factor in column 2 to get common units of energy (kWh is used for electricity and now for gas - conversion units are given in Appendix 2).
3. Enter the gross floor area of the building in column 4.
4. Divide the energy use of each fuel by the floor area to get energy use per unit area (kWh/m²) in column 5.
5. Add the fossil fuel figures together to get a fossil fuel index - the electricity figure can be used directly.
6. Compare the indices with yardsticks for the building type in figure 6.2 to give an energy performance assessment.

Note: this does not take account of the effect of weather on heating energy use (see section 6.4).

There may be exceptional reasons to explain a low or high consumption. For example, a building may have a low consumption because it is empty, or a high consumption because it has full air conditioning.

Even a building with a low consumption may have opportunities for cost-effective improvement.

Annual energy consumption of your building.

This is most conveniently obtained from past bills but take care that the figures collected represent a full year and are not "estimated" by the utility. It may be helpful to look at more than one year's bills providing that there have been no significant changes to the building or its use in that time. The numbers you require are the energy units consumed, not the money value. Include all fuels: solid fuel, bottled fuel, natural gas, oil and electricity.

Floor area information.

The measure of floor area used to standardise energy consumption is gross area, defined as total building area measured inside external walls.
If floor area is available as ft², convert to m² by dividing by 10.76.

Figure 6.1 Energy Performance Index Calculation

		Column 1 Annual Billed Units			Column 2 kWh* Conversion	Column 3 Annual kWh	Column 4 Gross floor area (m²) divide by	Column 5 Annual kWh/m²
Gas			kWh	x	1.0			
Oil type			litres	x				
Other Fossil fuel								
Total of fossil fuel								
Electricity			kWh	x	1.0			

Note * for kWh conversion factors see Appendix 2

The indices show which fuel requires the most attention. Section 4 then shows possible energy saving measures for each energy use. The next step is to select and progress suitable measures.

6.3 Overall yardsticks

Overall yardsticks based on carbon dioxide (CO_2) emissions or the cost of energy per m² of floor area can be used to provide a single performance index. These can be used to prepare league tables which compare groups of buildings or to assess buildings which have different fuel supply arrangements.

6.4 Refining the performance indices

If there is more information available, you may wish to assess your performance indices further in a number of ways as described in Appendix 1.

- If your building has unusual occupancy, or experiences unusual weather you may want to know their likely effect.
- You can compare your building performance with the 'Normalised Performance Indicator' used in previous editions of these guides.
- You may wish to take account of the effect of weather when comparing buildings in different parts of the country.

Figure 6.2 Energy Consumption Yardsticks

Performance Assessment

	Low consumption Less than	**Medium Consumption** Between	**High consumption** Greater than
	Yardsticks in kWh/m²		Yardsticks in kWh/m²
Buildings with a fossil fuel and electricity supply			
Post Offices			
Fossil fuels	140		210
Electricity	45		70
Banks and building societies			
Fossil fuels	70		100
Electricity	70		100
Agencies			
Fossil fuels	150		230
Electricity	55		75
Buildings which are electrically heated-electricity yardsticks			
Post offices	80		140
Banks and building societies	100		140
Agencies	90		160

7

A CLOSER LOOK AT ENERGY CONSUMPTION

7.1 Introduction

Often a fuller understanding of energy use in a building may be useful, for example after the initial measures have been undertaken, if there is a problem, if the building has poor performance or if it has unexpected energy bills. This section outlines techniques which you may find useful.

This section is applicable mainly to buildings with both a fossil fuel and electricity supply. All-electric buildings are much more difficult to analyse.

7.2 Monthly energy use

You can ask your supplier for monthly fuel data, or ask the building manager to take monthly meter readings.

Larger sites have monthly energy bills. By looking at how these vary with the seasons some valuable insights can be obtained. Produce a monthly consumptions bar chart plot for each energy source over a year.

The billing periods should be checked. If they are not regular, some months will appear unrealistically low and others unrealistically high. This is particularly likely in December and January. If this is the case the average daily consumption for each month can be plotted to give more accuracy.

The seasonal variation in electricity will depend on the level and type of services in the building.

Electricity consumption should decrease during summer in a building which is not air conditioned, because of lower lighting loads. In an air conditioned building, peaks in spring and autumn may indicate simultaneous heating and cooling.

Example monthly electricity use

The figure above shows monthly electricity consumption for an air conditioned building with fossil fuel heating. It shows a small increase in the summer months as the cooling load increases. In a building which is heated by a fossil fuel and which has no air conditioning, a small increase in electricity use in winter may be due to increased lighting or some electric heating. However, an all-electric building with air conditioning would probably have a fairly constant monthly electricity consumption owing to cooling in summer and heating in winter.

Fossil fuel consumption, used mainly for heating, should reduce greatly in summer - to zero if it is not being used for other services such as hot water or catering.

Example monthly fossil fuel use

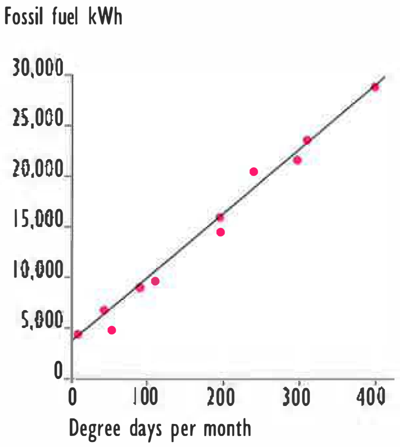
The figure above shows the monthly fossil energy consumption of a fairly efficient building which has a central boiler system for heating and hot water - the summer usage is much lower than winter usage and is at a fairly steady 'base load' level which suggests that the heating is off, though it is useful to confirm this by checking that heating pumps are off, and that pipework used solely for heating is cold.

This graph shows a base load, which helps to identify the hot water load and system losses, and the heating load which depends on the weather.

7.3 Relating heating use to weather

A fuel that is mainly used for heating should be used more in colder weather. The coldness of the weather can be expressed by a measure known as degree days. This shows by how much and for how long the outside temperature is below a control temperature (usually 15.5°C). Drawing a graph of fossil fuel consumption against the degree days for each month in the year shows how energy consuption is related to weather. Monthly figures for degree days for different areas of the country are published in the EEO's free bimonthly magazine 'Energy Management' (section 9.4).

Example monthly heating energy use in a well controlled building

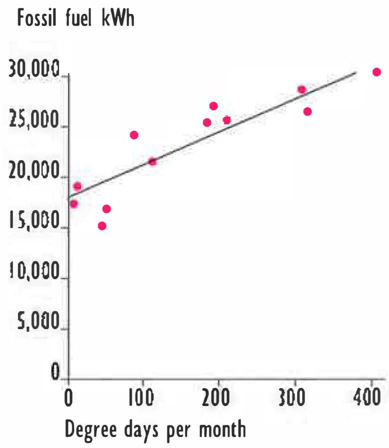


The building represented above has a well controlled heating system shown by the close fit of the points to the straight line. As the weather gets colder the energy used goes up proportionally. For this building the energy consumption falls to a small value in summer when only hot water is being provided.

The same plot can be drawn for electricity use in an electrically heated building as long as it is not air conditioned to any significant degree. The consumption in summer will reflect lighting, small power and electric domestic hot water use.

A building with better insulation would have a less steep slope because energy consumption in winter would be lower.

Example monthly heating energy use in a poorly controlled building



The figure above has a large scatter of points indicating a building with poor control. The energy use in the summer months remains higher than in the previous figure, indicating that either heating is being used unnecessarily in the summer or that the boiler and hot water systems have high losses which lead to excessive waste.

For further information see:

EEO Fuel Efficiency Booklet 7. Degree Days

7.4 Adjusting energy use for weather

Once you know how weather conditions affect energy use, it is possible to allow for varying conditions. For example, it is possible to take account of the weather when comparing a building energy performance from year to year. Such comparisons show with greater accuracy the effect of any energy saving measures.

In order to adjust for weather it is necessary to know how much of the fossil energy or electricity is used for heating and how much is a steady base load. The base load can be estimated by looking at the monthly consumption of fossil energy or electricity as shown in section 7.2 or the graphs of fossil fuel or electricity against degree days as shown in section 7.3, and the rest is the energy used for space heating which varies with weather conditions. These plots will not give you the proportion of electricity used for space heating in an all-electric building with air conditioning. In this situation an estimate would often have to be made (see figure A1.4 in Appendix 1).

8

CASE STUDIES

This section gives examples of organisations which have implemented a central energy management policy, and briefly reviews some branches where energy saving measures have been implemented.

The use of the Performance Index calculation is also demonstrated, both for assessing how energy efficient a building is, and as a means of evaluating the improvement in energy performance resulting from the implementation of energy saving measures.

8.1 Queen Street Post Office, Nottingham

Nottingham city centre's Queen Street Post Office is one of the largest in the Midlands. The Post Office is situated on the ground and part of the first floor of a six storey building which opened in 1972, although there has been a Post Office in Queen Street since 1896.

Energy performance

Gross floor area = 421 m²	
Gas consumption (kWh)	51439
Fossil fuel performance index (kWh/m²/yr)	122
Fossil fuel performance assessment	Low consumption
Gas consumption (kWh)	28712
Fossil fuel performance index (kWh/m²/yr)	68
Fossil fuel performance assessment	Medium consumption

The present building has two basement floors given over to car parking. The ground floor houses the public and counter areas of the Post Office and a small office. The first floor includes a rest room and small kitchen for staff. The Post Office leases the other floors to British Telecom whom it supplies with heat from boiler plant located on the ground floor.

By 1992, much of the heating and electrical equipment in the building was in need of replacement and the Post Office interior had long suffered from low lighting levels. The oil fired boilers were old, poorly controlled and becoming costly to maintain.

Heating and hot water plant was therefore replaced as part of a major refurbishment project and lighting was brought up to date. Interior decorations were also refurbished.

Improvements to heating system

The old boilers were replaced by two gas-fired condensing boilers. Condensing boilers operate at higher efficiencies than any other type of boiler, using an extra heat exchanger to reclaim some of the heat which would otherwise be lost in hot flue gases, and therefore have relatively low running costs.

A new microprocessor-based controller was fitted to control both the boilers and heating system as effectively as possible. The boilers supply a heating radiator circuit in the Post Office and a separate, heat-metered circuit for BT on the other floors. The two circuits are controlled separately, using different programs on the controller. Each has optimum start control and weather compensation, allowing the condensing boilers to operate at maximum efficiency. The controller also sequences the boilers to ensure that heat output closely matches the load and that the boilers run for roughly equal times.

Domestic hot water system

Domestic hot water in the Post Office is now supplied by local electric point-of-use heaters. This provides a more efficient method of producing small quantities of hot water than operating the large heating boilers in summer months.

Ventilation system

The Post Office incorporates a small mechanical fresh air supply fan to ventilate the counter area. The need for air conditioning was marginal and was therefore rejected on capital cost grounds.

Improvements to lighting

High efficiency lighting systems were installed as part of the refurbishment. These included new efficient 26mm diameter fluorescent lamps, housed in modular fittings with reflectors (reflectors are usually more efficient than diffusers), which have also increased the illuminance level from 200 to 600 lux. The increase in illuminance helps counter staff carry out their work effectively. Lighting in the underground car parks is for safety and security and is controlled by a time clock.

User reaction

The combined refurbishment of heating plant, lighting and decor has transformed the performance and appearance of the Post Office. The increase in illuminance in particular has helped provide a better working environment for staff and a more inviting interior for customers. The manager is very pleased with the effect and feels that the improved environment has brought new business to the Post Office whilst keeping energy costs to a minimum.

"It's a much more pleasant environment to work in and many members of the public have commented on the improvement", says the Manager.

8.2 Lloyds Bank

With an energy bill of several million pounds, Lloyds Bank recognises this as a controllable operating cost, having a direct impact on profits. It therefore has an energy policy which incorporates a number of key features:

- The Bank operates a monitoring and targeting system to keep track of energy consumption at all Lloyds branches
- Energy consumption targets are set for each branch - where branches miss targets significantly site visits are made to investigate why
- Energy efficiency is included in specifications for new buildings and building refurbishments, together with ongoing maintenance
- Literature on 'good housekeeping' measures is distributed to all Branch Managers.

"There is no point in flagging all branches as poor. It is much more effective to use the M&T system as a way of targeting the worst branches for action. This allows remedial actions to be focused and enables the targets affecting all branches to be progressively tightened over time", says the Lloyds Energy Manager.

Great Missenden Branch

The Great Missenden branch is a typical small high street bank serving mainly personal customers. It employs 12 staff and is open for business from 9.30 am to 4.30 pm five days a week but staffed from 8.15 am to 6 pm. It occupies a traditional two storey building dating from the late 1800s. The building is naturally ventilated with opening windows, some of which have secondary glazing.

The ground floor houses the banking hall, open offices for cashiers and clerks, the manager's office, a machine area and the strong room. The first floor is smaller, accommodating the staff room, stationery store, toilets and the boiler room.

Heating, cooling and hot water

The building is heated by a gas-fired boiler serving radiators, some with thermostatic radiator valves. The heating system is controlled as one zone as the building is too small for separate zones.

A split system, comfort cooling unit provides local cooling in the main office only which has high internal heat gains from IT equipment. This avoids the high capital and running costs of full air conditioning.

Domestic hot water is heated from the main central heating boiler in winter and by an electric immersion heater in summer. This arrangement means the boiler is not firing wastefully in summer to provide small hot water loads. An instantaneous water heater provides hot water for the staff kitchen as this is some distance from the boiler room, thus avoiding heat losses from long pipe runs.

A microprocessor-based energy controller was installed in 1992 to replace a simple time clock on the boiler. The menu-driven device controls the boiler directly using self-learning weather compensation and optimum start and stop functions. After initial setting, the controller automatically fine tunes itself to match the building's requirements.

"Equally important, the controller is very easy to set and alter. Heating and hot water can be programmed separately on a seven day basis and holiday dates can also be programmed in. One of the things we looked for in a controller was a good user interface, so that staff can easily pick up how to use it", says the Lloyds Energy Manager.

"The branch is more comfortable to work in now, partly because we can alter settings more easily", says the branch Operations Manager.

Lighting

Lighting in the branch is by 26mm fluorescent lamps in modular luminaires, with added downlighters over the cash desks. The slim, 26mm fittings are more efficient than their 38mm predecessors. Exterior sign lighting is controlled in relation to hours of darkness by progressively altering settings on a time clock.

Energy performance

Gas consumption has fallen by 40% since the new controller was fitted. In recent years, electricity consumption has risen steadily despite the low energy lighting installation. This has been due to a proliferation of office equipment such as Cashpoint machines, photocopiers, computers and a banking communications system. The effect of this increase highlights the importance of selecting low energy office equipment and encouraging staff to switch off when possible.

Improvement in energy consumption

Gross floor area = 215 m²

	1992	1993
Gas consumption (kWh)	31010	17967
Fossil fuel performance index (kWh/m²/yr)	144	84
Fossil fuel performance assessment	High consumption	Medium consumption

8.3 Barclays Bank

Barclays are committed to reducing energy costs. In 1992 they signed up to the EEO's Making a Corporate Commitment campaign.
Their energy bill is around £26 million a year, which represents a large controllable cost. Energy use at its branches is supervised by Barclays Property Holdings Ltd, which has carried out energy surveys at over 2000 branches since 1980. Energy efficiency is considered whenever plant and equipment are replaced or can be upgraded.

"We try to discourage the use of air conditioning within branches as this is the real energy guzzler", says the Energy Manager for Barclays Property Holdings.

The energy costs and consumption of around 1800 branches are logged using an in-house monitoring and targeting system. Performance reports and new targets are fed back annually to encourage further savings. Larger branches log their own consumption in more detail using meter readings. Barclays also produces brochures to motivate staff and organises annual seminars on energy efficiency for regional premises managers.

Fitzalan Square Branch, Sheffield

The Fitzalan Square branch of Barclays Bank employs around 100 staff. It occupies a substantial, four storey building in the city centre. The banking hall and service area are on the first floor. The second and third floors house offices and the two basement floors are given over to parking. Four retail units are incorporated into the building at street level.

Heating and ventilation system

In 1990 the heating plant controls were upgraded to include optimum start and weather compensation. In 1991 the boilers were replaced by a connection to the local district heating scheme. In Sheffield, municipal waste is incinerated and the heat recovered and sold to buildings in the city via a network of insulated hot water pipes. This type of scheme is environmentally sound because energy is recovered from rubbish, which has to be disposed of anyway, avoiding the need to burn fossil fuels. Connection to a district heating scheme also means that the bank does not have to bear the cost of maintaining boilers.

Two heat exchangers in the basement transfer heat to the bank's systems. The heat output from the heat exchangers is controlled in exactly the same way as heat from boilers.

The building has a mixture of heating and ventilation systems. Some areas are naturally ventilated with opening windows, of which some are doubled glazed, others are provided with ducted warm air and a small number of split cooling units cope with local overheating owing to heat from equipment. This mixed approach minimises energy use while ensuring that staff are comfortable.

The ventilation system also incorporates run around coils to reclaim heat from the warmer extract air and two speed fans to match power to demand and maximise efficiency.

Lighting system

Internal lighting is mainly 26mm fluorescent lamps, which are more efficient than their 38mm predecessors. The new lighting system at the branch is *"far brighter than the old one and much better for customers"*, says the Operations Manager. Corridors are lit by compact fluorescent lamps.

Building energy management system (BEMS)

A BEMS was installed in 1993 and subsequently upgraded to include a panel in the offices which staff can use and easily interpret. The panel indicates temperatures in the various zones (including logged graphs), plant status and readings on the heat meters for the district heating. It includes a touch screen menu system which the Operations Manager finds *"really easy to use and very helpful"*.

The new BEMS controls the various heating zones, domestic hot water, ventilation and lighting for both the bank and its tenant retail outlets. It also incorporates optimum start. Tenants have a separately metered electricity supply and heat supplies so that they are charged for what they use rather than according to floor area. This is important as it encourages tenants to be energy efficient.

The BEMS also controls lighting within the building as well as substantial amounts of external floodlighting using photocells.

Energy performance

The electricity performance index in 1992/93 was 67 kWh/m², a low consumption figure. It is not possible to calculate a fossil fuel performance index because the source of heat is municipal waste via the district heating main. Hence there are no losses within the bank from converting gas or oil to heat, as opposed to a building which has its own boiler.

ADVICE AND HELP

9.1 The Energy Efficiency Office

The Energy Efficiency Office (EEO) is part of the Department of the Environment.

The EEO currently aims to achieve environmental and economic benefits by promoting cost effective energy efficiency measures in the industrial, commercial, domestic and public sectors of the economy by:

- Raising awareness
- Identifying and overcoming barriers to action
- Providing financial incentives where appropriate
- Regulation where necessary
- Providing technical advice.

9.2 Best Practice Programme

The EEO's Best Practice programme gathers and disseminates authoritative information on cost effective energy saving measures. The Best Practice programme for buildings is managed on behalf of the EEO by the Building Research Energy Conservation Support Unit (BRECSU) and for industry by the Energy Technology Support Unit (ETSU).

A range of publications is available under the Best Practice programme, normally free of charge. Relevant titles for Post Offices, banks, building societies and agencies are listed here.

Good Practice Guides give advice on how to implement energy saving measures. Relevant titles are as follows:

33 Understanding energy use in your office

34 Energy efficient options for new offices - for the design team

35 Energy efficient options for refurbished offices - for the design team

46 Heating and hot water systems in offices

71 Selecting air conditioning systems

84 Managing and motivating staff to save energy.

General Information Leaflets and Reports also give advice on how to implement energy saving measures. Relevant titles are:

1 The success of condensing boilers in non-domestic buildings. A user study

6 Energy efficiency in office lighting.

Information on energy management is contained in these General Information Reports:

12 Organisational aspects of energy management

13 Reviewing energy management

14 Energy management of buildings including a review of some case studies.

Fuel Efficiency Booklets are working manuals which provide detailed technical guidance on specific areas of energy use in buildings and industry. Relevant booklets are:

1 Energy audits for buildings
7 Degree days
8 The economic thickness of insulation for hot pipes
9 Economic use of electricity in buildings
10 Controls and energy savings
12 Energy management and good lighting practices.

In addition, a wide range of events is organised to promote the results of the Best Practice programme. These include seminars, workshops and site visits and are targeted at different sectors and professionals.

Details of publications and events can be obtained from:

BRECSU (for buildings)
Building Research Establishment
Garston
Watford WD2 7JR
Tel: 0923 664258
Fax: 0923 664097

ETSU (for industrial sectors)
Harwell
Didcot
Oxon OX11 ORA
Tel: 0235 436747
Fax: 0235 432923.

9.3 Other publications available from BRECSU

Energy Efficient Lighting in Offices (1992). A THERMIE Maxibrochure.

9.4 Free Publications From the EEO

The Introduction to Energy Efficiency series. There are 13 Guides in this series, of which this is one:

Catering establishments
Entertainment buildings
Factories and warehouses
Further and higher education
Health care buildings
Hotels
Libraries, museums, galleries and churches
Offices
Post Offices, banks, building societies and agencies
Prisons, emergency buildings and courts
Schools
Shops and Stores
Sports and recreation centres

Choosing an Energy Efficiency Consultant (EMAS 2)

Practical Energy Saving Guide for Smaller Businesses (ACBE 1)

The above are all available from:
Department of the Environment
Blackhorse Rd
London SE99 6TT
Tel: 081 691 9000

The 'Energy Management' journal. Published bi-monthly and available from the EEO.
Tel: 071 276 6200.

9.5 Other EEO Programmes

Making a Corporate Commitment Campaign

The 'Making a Corporate Commitment' campaign seeks board level commitment to energy efficiency. It encourages directors to sign a Declaration of Commitment to responsible energy management, prepare a business plan for energy efficiency and ensure that it becomes an item that is considered regularly by their main board.

Publications:

Chairman's Checklist
Executive Action Plan
Energy, Environment and Profits - Six case studies on corporate commitment to energy efficiency.

Further information is available from the Campaign Offices on 071 276 4613.

Energy Management Assistance Scheme

The Energy Management Assistance Scheme may provide support for small and medium sized businesses (up to 500 employees) to employ an energy consultant. This aims to upgrade the expertise in energy efficiency among smaller companies, and tackle the capital priority barrier through financial support.

Further information can be obtained on 071 276 3787.

9.6 Sources of Free Advice and Information

Regional Energy Efficiency Officers

11 Regional Energy Efficiency Officers (REEOs) around the UK can provide copies of all the EEO's literature and give specific advice on:

- opportunities for better energy efficiency in your organisation
- technologies and management techniques you should be thinking about
- appropriate sources of specialist advice and assistance in the private sector
- EEO programmes
- regional energy managers' groups.

REEO Northern Region
Wellbar House
Gallowgate
Newcastle Upon Tyne NE1 4TD
Tel: 091 201 3343

REEO Yorkshire and Humberside
City House
New Station Street
Leeds LS1 4JD
Tel: 0532 836 376

REEO North West
Sunley Tower
Piccadilly Plaza
Manchester M1 4BA
Tel: 061 838 5335

REEO East Midlands
Cranbrook House
Cranbrook Street
Nottingham
Nottinghamshire NG1 1EY
Tel: 0602 350 602

REEO West Midlands
Five Ways Tower
Frederick Road
Birmingham B15 1SJ
Tel: 021 626 2222

REEO Eastern
Heron House
49-53 Goldington Road
Bedford MK40 3LL
Tel: 0234 276 194

REEO South West
Tollgate House
Houlton Street
Bristol BS2 9DJ
Tel: 0272 218 665

REEO South East
Charles House
Room 565
375 Kensington High St
London W14 8QH
Tel: 071 605 9160

REEO Scotland
New St Andrews House
Edinburgh
Scotland EH1 3TG
Tel: 031 244 1200

REEO Wales
Cathays Park
Cardiff
Wales CF1 1NQ
Tel: 0222 823 126

REEO Northern Ireland
Dept of Economic Development
Netherleigh House
Massey Avenue
Belfast
N Ireland BT4 2JT
Tel: 0232 529900.

9.7 Other Programmes

Energy Design Advice Scheme

The Energy Design Advice Scheme is a Department of Trade and Industry discretionary initiative aimed at improving the energy and environmental performance of the building stock by making low energy building design expertise more accessible for the energy efficient design and refurbishment of buildings. The scheme offers support, via a number of Regional Centres, to design teams or clients in the energy aspects of design of new buildings or refurbishment projects over 500m² gross area.

Further information can be obtained from the following Regional Centres:

For Scotland
Tel: 031 228 4414

For South East England
Tel: 071 916 3891

For Northern England
Tel: 0742 721 140

For Northern Ireland
Tel: 0232 364 090.

EU Programmes

Several EU programmes aimed at demonstrating energy efficiency measures and encouraging energy efficiency R&D. Details change periodically. For further information contact BRECSU for buildings and ETSU for industry.

9.8 Other Publications

Chartered Institution of Building Services Engineers (CIBSE):

CIBSE Applications Manual, AM 5:1991, Energy Audits and Surveys

CIBSE Applications Manual, AM 6:1991, Contract Energy Management

CIBSE Applications Manual, AM3, Condensing Boilers

CIBSE Applications Manual, AM8, Private and Standby Generation of Electricity

CIBSE Code for Interior Lighting (1984)

CIBSE Lighting Guide 3(LG3)(1989). Areas for Visual Display Terminals.

Available from:

CIBSE, 222 Balham High Rd,
Balham,
London SW12 9BS.
Tel: 081 675 5211
Fax: 081 675 5449.

Heating and Ventilating Contractors Association (HVCA):

Standard Specification for Maintenance of Building Services. Volumes 1 - 5. 1990 - 1992.

Available from:

HVCA Publications, Old Mansion House, Earmont Bridge, Cumbria, CA10 2BX
Tel: 0768 64771.

9.9 Other Useful Addresses

Energy Systems Trade Association Ltd (ESTA)
PO Box 16, Stroud, Gloucestershire
GL6 9YB
Tel: 0453 886776
Fax: 0453 885226

Major Energy Users' Council
10 Audley Road
London W5 3ET
Tel: 081 997 2561/3854
Fax: 081 566 7073.

APPENDIX 1

Development of Building Performance Indices (PI)

Introduction

This section outlines how to calculate environmental and cost indices for the energy used in your building. It describes the effect of weather and building occupancy on the performance of a building, with a method to allow for these factors if required.

Adjustments of the PI for these factors produces a 'Normalised Performance Index' (NPI) which is compatible with earlier versions of this guide. For many purposes, the effect of these factors on performance indices is small enough to be ignored.

Figure A1.1
CO_2 Performance Index Calculation

	Column 1 Annual energy use kWh/m²	Column 2 CO_2 conversion* factors kg/kWh	Column 3 Annual CO_2 emissions kg/m²
Gas		x 0.20	
Oil		x 0.29	
Coal		x 0.32	
Electricity		x 0.70	
Total CO_2 emissions per m²			

*typical 1993 emission factors

Figure A1.2
Cost Performance Index Calculation

	Column 1 Annual energy use kWh/m²	Column 2 Cost conversion factors £/kWh*	Column 3 Annual cost £/m²
Gas		x 0.014	
Oil		x 0.012	
Coal		x 0.009	
Electricity		x 0.071	
Total energy cost per m²			

*typical 1992 prices

Overall performance indices

Overall performance indices provide a single measure of building performance, and can be expressed in terms of carbon dioxide (CO_2) emissions or energy cost. Overall energy indices are useful for comparing a stock of buildings. However, separate fossil fuel and electricity performance indices are more useful to assist in deciding a course of action.

To calculate overall performance indices you need the annual energy use indices as obtained in figure 6.1 and conversion factors for each of the fuels - some of which are given in figures A1.1 and A1.2. The calculation procedure is to enter the kWh/m² figure in Column 1, and multiply by the relevant conversion factors in column 2 to get either the kg of CO_2 per m² or the cost per m² in column 3.

The conversion factors shown are broadly representative of the current fuels used in Post Offices, banks, building societies and agencies and can be used if a consistent set of factors is required. CO_2 factors, particularly for electricity, may vary from this data. Cost factors will also vary over time and as a function of use. Energy unit costs in larger buildings tend to be cheaper than for smaller supplies. You may wish to use your own costs from your own bills instead of those given here.

Overall yardsticks for CO_2 emissions or energy costs can also be calculated, by inserting yardstick energy consumptions (given in figure 6.2) into column 1. These can be compared with the actual index for your building to give an overall assessment. CO_2 and cost yardsticks calculated on the basis that the fossil fuel is gas are presented in figure A1.3.

Effect of weather on energy use

Weather changes from year to year for a given site cause variations in fossil/heating energy use of typically ±5% from the average values or ±10% in more extreme years.

Weather differences across the country cause variation in heating requirements of typically ±10% from average values and ±20% in more extreme areas.

The effect on electricity use will be small unless electricity is used for space heating, or in air conditioned buildings where the cooling energy will be higher during a warm summer.

Hours that the building is occupied (occupancy)

Occupancy affects buildings' energy use in different ways for different systems. Heating energy in a naturally ventilated heavy building varies very little with occupancy - say 5%. If a building has a light weight structure, or is mechanically ventilated or air conditioned, the heating energy may increase in more direct proportion to the occupied hours, giving 20% variation or more from the typical occupancy.

Electricity consumption of a badly controlled building will be almost independent of the occupancy, owing to lights and services left on from early morning to last thing at night. But for a well controlled building, both lights and plant may operate in direct proportion to occupancy.

Normalised performance indices

It is possible to adjust (normalise) performance indices for weather and extended occupancy, but care is needed as incorrectly applied adjustments, or adjustments that are too simplistic, may introduce larger

errors than the typical variations discussed above. For example, the effect of extended hours of use on energy consumption can easily be exaggerated, making the building performance seem better than is really the case.

Note also that while a normalised performance index is a better measure of a building's efficiency than an unnormalised index, the latter shows the building's actual performance. So a building with a low normalised performance index, but a high performance index before adjustment, is efficient, but since it is still a high user of energy, it may well offer good opportunities for cost effective energy saving.

Figure A1.4 can be used to obtain performance indices which are normalised to standard conditions of weather and occupancy. This is useful if:

- You require normalised performance indices for compatibility with previous work
- Any of the factors cause significant errors (see above sub sections to evaluate this).

A normalised performance index based on overall CO_2 emissions or energy cost is obtained by using figure A1.1 or A1.2 and inserting the normalised performance indices for each fuel into Column 1. If more than one fuel is used for heating, calculate a separate normalised performance index for each fuel first and then use this procedure.

Figure A1.3 Carbon dioxide and cost yardsticks

CO_2 Performance Assessment

	Low Emissions Less than	Medium Emissions Between	High Emissions Greater than
	Yardsticks in kg CO_2/m²		Yardsticks in kg CO_2/m²
Buildings with a fossil fuel and electricity supply			
Post Offices	60		90
Banks and building societies	63		90
Agencies	69		99
Buildings which are electrically heated			
Post Offices	56		98
Banks and building societies	70		98
Agencies	63		112

Cost Performance Assessment

	Low Cost Less than	Medium Cost Between	High Cost Greater than
	Yardsticks in £/m²		Yardsticks in £/m²
Buildings with a fossil fuel and electricity supply			
Post Offices	5.2		7.9
Banks and building societies	6.0		8.5
Agencies	6.0		8.5
Buildings which are electrically heated			
Post Offices	5.7		9.9
Banks and building societies	7.1		9.9
Agencies	6.4		11.4

CO_2 and cost yardsticks are based on factors given in figures A1.1 & A1.2

Performance indices - summary

- Simple performance indices are for initial energy assessments. Separate performance indices are calculated, one for fossil fuels and one for electricity use, and no adjustments are made.
- Overall performance indices, based on carbon dioxide (CO_2) or cost, are normally used when the energy supply arrangement is not typical or when a number of buildings are to be compared. Also, you may want to know the cost or the CO_2 performance for a single branch.
- Normalised performance indices are used when more sensitive comparisons are required and the effect of factors such as weather and occupancy become significant. But if you choose to normalise, be aware of introducing errors.

Figure A1.4 Normalised Performance Indices calculation

	Fossil fuel: Gas	Fossil fuel: Oil	Fossil fuel: Other		Total of Fossil Fuels	Electricity
Total energy consumption (kWh)				(A)		
Space heating energy (kWh)				*(B)		
Non space heating energy (kWh)				A-B = (C)		
Find the degree days for the energy data year				*(D)		
Weather correction factor = 2462 ÷ D =				(E)		
Obtain occupancy factor for heating energy use from below				*(F)		
Annual heating energy use for standard conditions				BxExF = (G)		
Obtain occupancy factor for non-heating energy from below				*(H)		
Annual non-heating energy use = C x H =				(J)		
Normalised energy use = G + J =				kWh (K)		
Find floor area				m^2 (L)		
Find the Normalised Performance Indices = K ÷ L =				kWh/m^2 (M)		

* Notes:
(B) Estimation of weather-dependent heating energy use is discussed in section 7.
If you have an all electric building and cannot separate out space heating assume that for Post Offices and agencies 60% of the electricity is used for space heating and that for banks and building societies 30% of the electricity is used for space heating.
(D) For degree day information, see Fuel Efficiency Booklet 7 - Degree Days
Monthly degree day figures are published in 'Energy Management' (see section 9.4)
(F) and (H) Occupancy factors from figure A1.5.

Figure A1.5 Occupancy Factors

	Factor for heating energy (F)	Factor for non-heating energy (H)
Normal building occupancy: (5 - 5½ days, 10 hours per day)	1.00	1.00
Lightweight building Extended occupancy	0.85	0.80
Other buildings Extended occupancy	0.95	0.80

APPENDIX 2

Energy Conversion Factors

The unit of energy used in this guide is the kilowatt - hour (kWh). One kilowatt - hour is consumed by a typical one bar electrical fire in one hour. For fuels which are metered in other units, multiply the metered value by the relevant conversion factor from the following table to obtain the value in kWh.

Figure A2.1 Conversion to kWh

	kWh conversion
Light Fuel Oil	11.2 kWh/litre
Medium Fuel Oil	11.3 kWh/litre
Heavy Fuel Oil	11.4 kWh/litre
Gas Oil (35 second)	10.8 kWh/litre
Kerosene - burning oil 22 second	10.4 kWh/litre
Electricity	[Metered directly in kWh]
Natural gas	29.31 kWh/therm
Liquid Petroleum Gas (LPG) (Propane)	6.96 kWh/litre
Coal (washed shingles)	7,900 kWh/tonne
Coal (washed smalls)	7,800 kWh/tonne